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WESTERN DISTURBANCES

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Western Disturbances are low-pressure areas embedded in the Westerlies, the planetary winds that blow from west to east between 30 and 60° latitude. They originate in the Mediterranean region, travel westward and enter India loaded with moisture, where the Himalayas obstruct them, causing rain and snow over northern India. The moisture in these storms usually originates over the Mediterranean sea and Atlantic Ocean. WDs are important to the development of the Rabi crop in the northern subcontinent.

The frequency of western disturbance amplified because of presence of easterlies from Bay of Bengal. Also due to pronounced warming over the Tibetan plateau in recent decades which can be attributed to climatic warming, favours enhancement of meridional temperature gradients. The warming in recent decades over west central Asia led to an increase in instability of the western winds thereby increasing WDs leading to a higher intensity for heavy precipitation.

Such disturbances can damage crops resulting into economic as well as agricultural loss for the people and farmers. Farm output is affected when crops that are ready to be harvested or about to ripen, get soaked in excessive rainfall. This is a concern in states like Madhya Pradesh, Gujarat, Maharashtra and Rajasthan, Punjab and Haryana.

I.INTRODUCTION

Western disturbances are low-pressure areas embedded in the Westerlies, the planetary winds that flow from west to east between 30°-60° latitude. They usually bring mild rain during January-February, which is beneficial to the rabi crop. But in the past few years western disturbances have been linked to disasters.

According to Dr R.M. Saxena, Professional Meteorologist at Skymet Weather defines Western Disturbance as "a low pressure area or a trough over surface or the upper-air in the westerly winds regime, north of 20°N, causing changes in pressure, wind pattern and temperature fields. It is accompanied by cloudiness, with or without precipitation." The term Western Disturbance (WD) was coined by Indian meteorologists for describing the systems moving from the west to east direction. An 'active' (intense) western disturbance affecting North and North-West India has brought the first round of organised showers for the region after the North-East monsoon yielded deficient rain and the dawn of the New Year hardly any. Western disturbances are low-pressure waves that travels from West to the East across the plains and modulates the winter with associated snow/ice, fog or showers depending on their intensity.

Western disturbances occur during the cold, dry season. The weather is fine with clear skies, low temperatures and humidity, cool breeze and rainless days. However, these fine weather conditions at intervals get disturbed by shallow cyclonic depressions. These depressions—also known as western disturbances—originate over the

east Mediterranean Sea and travel eastwards across West Asia, Iran-Afghanistan and Pakistan before they reach the north-western parts of India. On their way, they pick up moisture from the Caspian Sea in the north and the Persian Gulf in the South.

Although the western disturbances cause meagre rainfall, even this little amount of rainfall is highly beneficial to the rabi crops, especially wheat. The precipitation is in the form of light rains in the plains and heavy snowfall in the western Himalayas, It is this snow that sustains the flow of water in' the Himalayan rivers during the summer months.

II.FORMATION

Western disturbances originate in the Mediterranean region. A high-pressure area over Ukraine and neighborhood consolidates, causing the intrusion of cold air from Polar Regions towards an area of relatively warmer air with high moisture. This generates favorable conditions for cyclogenesis in the upper atmosphere, which promotes the formation of an eastward-moving extra tropical depression. Traveling at speeds up to 12 m/s (43 km/h; 27 mph), the disturbance moves towards the Indian subcontinent until the Himalayas inhibits its development, upon which the depression rapidly weakens. The Western Disturbances are embedded in the mid-latitude Subtropical Westerly Jet.

Scientists agree that western disturbances are formed naturally. They originate in the Mediterranean region and travel over Iran, Iraq, Afghanistan and Pakistan to enter India loaded with moisture, where the Himalayas obstruct them, causing rain and snow in western Himalayas. The snow adds to the glaciers which provide water to India's major perennial rivers. But we need to understand why this beneficial weather phenomenon increasingly disastrous.

III.FOLLOWING VIEWS ARE SIGNIFICANT

1. According to IMD, the severe rain this year is the result of the confluence of western disturbance and easterly wave from the Bay of Bengal. Easterly wave, or Easterlies, blow throughout the year from east to west. The confluence of the two winds happens throughout the year, but the results vary. They generally bring rain only to the northern part of the country but this year states in central and south India also received rain. Western parts of Madhya Pradesh, for instance, received over 2,025 times more than usual rainfall during March 1-18, while the rainfall in central Maharashtra was 3,671 times above normal(IMD data).

2. A phenomenon called Pacific Decadal Oscillation (PDO) is said to have contributed to the severity of this year's rainfall. PDO is the name given to long-term fluctuations in the surface temperature of the Pacific Ocean.

3. Widely used weather models, such as the Global Forecast System, are consistently showing the movement of new upper air troughs into India. Such troughs in the jet streams (narrow bands of strong winds flowing in the upper troposphere) could be affecting the western disturbances which, IMD says, are present in the lower and middle troposphere. One such trough started forming in the upper troposphere over Iran, Afghanistan and Pakistan on February 26 and intensified and moved towards north-western parts of India on February 28. This

led to the formation of a low-pressure region in the lower troposphere over northwest India, causing an incursion of moisture from Arabian Sea, and produced heavy rains. This shows how problematic the combination of western disturbances and upper air troughs can be for India.

4. Climate change induced: A study by the Indian Institute of Tropical Meteorology (IITM), Pune, has directly linked western disturbances to global warming. Researchers say global warming is impacting air currents and causing freak weather events. Pronounced warming over the Tibetan plateau in recent decades has increased the instability of the Westerlies and this has increased the variability of the western disturbances. According to the study, the western Himalayan region has seen a significant rise in surface temperatures since the 1950s. Observations from the area show a significant increase in precipitation in recent decades.

IV. INFLUENCE OF OF WESTERN DISTURBANCE OVER CROPS

The crop growth and yield are greatly influenced by air temperature, soil temperature, relative humidity, duration and quality of light, solar radiation, surface wind, cloudiness and precipitation. All these climatic parameters are modified with the arrival of western disturbance.

It has been observed that production of rabi crops is adversely affected in the absence of western disturbance, even if they are raised under irrigated conditions.

Rabi crops during winter season are greatly influenced by the arrival of western disturbance. It brings cloudiness and precipitation in many parts of north India during rabi season. Rabi crops, particularly wheat crop, sown under rainfed conditions is greatly benefited by the arrival of WD.

Precipitation caused by WD during the months of October and November is favourable for the sowing of wheat crop in those areas where the irrigation facilities are not available. The amount of rainfall depends upon the intensity and duration of western disturbances. At the same time, a WD provides required moisture to the wheat crop at different phenological stages during its life cycle.

Reproduction stage of wheat crop passes through the months of February and March under Punjab conditions. Moisture deficiency during this stage has detrimental effect on the grain yield of wheat crop. Apart from rainfall, temperature has great impact on the grain formation stage for wheat crop sown under irrigated and rainfed conditions.

The arrival of WD not only provides required moisture but also modifies the climatic conditions. The day temperature of 26°C and night temperature of 12°C are favourable for the grain formation of wheat crop under Punjab conditions.

Wheat production has undergone large variations due to high degree of climatic variability during growing season. The climatic variability in the state during rabi season may be attributed to the western disturbances. The duration and frequency of western disturbance plays an important role during the life cycle of wheat crop.

The frequency and duration of western disturbance may be favourable or unfavourable depending on their occurrence at different stages of crop growth affecting overall grain yield. Wheat crop has to pass through a critical stage during the months of March and April.

Higher frequency and duration of western disturbances during these two months adversely affect the grain formation stage by changing the temperature conditions.

The crop physiology and accumulation of photosynthates are adversely affected by the changes in temperature conditions. All stages of the crop development are sensitive to temperature fluctuations and contribute to rate of crop development.

Variation in the intensity of light also affects the morphological and physiological processes and grain yield. Rawson (1998) suggested that effect of temperature was more important during vegetative growth as well as grain formation of wheat. The grain number and grain weight are reduced due to prolonged high temperature and drought conditions.

In the absence of western disturbances, unfavourable weather conditions are experienced by wheat during grain formation stage during the month of March. But the arrival of western disturbances contributes positively towards grain yield by modifying the weather conditions particularly at grain formation stage. It may contribute negatively when the intensity and duration of western disturbances increases.

North-west India, particularly Punjab has witnessed abnormal weather conditions during rabi season in many years. In 1982, 1987 and 1997, wheat experienced unfavourable conditions created by increased frequency of western disturbances.

Thus, losses worth crores of rupees were caused due of drastic decrease in wheat production during 1982-83, 1986-87 and 1997-98. The occurrence of such type of unfavourable conditions during reproductive phase of wheat crop cannot be ruled out in the near future.

V.PREDICTION OF WESTERN DISTURBANCE DURING 2018

An ‘active’ (intense) western disturbance affecting North and North-West India has brought the first round of organised showers for the region after the North-East monsoon yielded deficient rain and the dawn of the New Year hardly any.

Western disturbances are low-pressure waves that travels from West to the East across the plains and modulates the winter with associated snow/ice, fog or showers depending on their intensity.

‘Low’ over Rajasthan

Tuesday’s disturbance has, in fact, set up a rare low-pressure area over North-East Rajasthan and adjoining West Madhya Pradesh over Punjab, Haryana, Chandigarh, Delhi and Rajasthan.

The ‘low’ has forced a reigning cover of dense fog, and along with it the cold wave, to migrate to East India. Western disturbances bring in the winds, moisture, warmth and clouds. Hence the showers, snow, and even hail.

The region not affected by the disturbance witnesses sinking motion of air, which brings in the cold Arctic winds to settle and lower the temperatures.

The India Met Department (IMD) has forecast heavy rain/snowfall over Uttarakhand on Wednesday when the weather peaks. Hailstorms are likely at isolated places over Punjab, Haryana, Himachal Pradesh, Uttarakhand and west Uttar Pradesh.

Rain, snow forecast

Fairly widespread to widespread rainfall/snowfall is likely over Jammu & Kashmir and Himachal Pradesh. Isolated to scattered activity likely over the same and over Punjab, Haryana, Chandigarh, Delhi and West Uttar Pradesh on Thursday also.

East Uttar Pradesh and Bihar are other areas expected to receive showers in line with the eastward movement of the disturbance.

Along with this, mercury would start plunging over North-West India as the eastward moving disturbance carries its rain-head towards the East f the country (including East Uttar Pradesh and Bihar).

The next western disturbance, a moderately strong one, is expected to arrive over North-West India by the end of the month.

VI.CONCLUSION

Cyclonic storms associated with the mid-latitude Subtropical Westerly Jet (SWJ), referred to as Western Disturbances (WDs), play a critical role in the meteorology of the Indian subcontinent. WDs embedded in the southward propagating SWJ produce extreme precipitation over northern India and are further enhanced over the Himalayas due to orographic land-atmosphere interactions. During December, January and February, WD snowfall is the dominant precipitation input to establish and sustain regional snowpack, replenishing regional water resources. Spring-melt is the major source of runoff to northern Indian rivers and can be linked to important hydrologic processes from aquifer recharge to flashfloods. Understanding the dynamical structure, evolution-decay and interaction of WDs with the Himalayas is therefore necessary to improve knowledge which has wide ranging socio-economic implications beyond short-term disaster response including cold-season agricultural activities, management of water resources, and development of vulnerability-adaptive measures. In addition, WD wintertime precipitation provides critical mass input to existing glaciers and modulates the albedo characteristics of the Himalayas and Tibetan Plateau, affecting large-scale circulation and the onset of the succeeding Indian Summer Monsoon. Assessing the impacts of climate variability and change on the Indian subcontinent requires fundamental understanding of the dynamics of WDs. In particular, projected changes in the structure of the SWJ will influence evolution-decay processes of the WDs, and impact Himalayan regional water availability.

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